

P-5.1 Analyze the relationships among the properties of waves (including energy, frequency, amplitude, wavelength, period, phase, and speed).

Revised Taxonomy Level 4 Analyze conceptual knowledge

In physical science students

- ❖ “Compare the nature and properties of transverse and longitudinal/compressional mechanical waves.” (PS-7.2) and
- ❖ “Summarize characteristics of waves (including displacement, frequency, period, amplitude, wavelength, and velocity as well as the relationships among these characteristics).” (PS-7.3)
- ❖ “Use the formulas $v = f\lambda$ and $v = d/t$ to solve problems related to the velocity of waves.” (PS-7.4)

In physics, students will look at these same characteristics but they will now analyze these properties and characteristics. Students will analyze both conceptually and analytically.

It is essential for students to

- ❖ Understand both conceptually and analytically the factors that affect the properties of a wave
- ❖ Summarize each property and characteristic in terms of
 - The physical effect that each property or characteristic has on the wave
 - The factors which influence each property or characteristic
 - The ways that each property or characteristic is measured
 - The symbol for each property or characteristic and the units that are used to measure it.
 - The mathematical relationship between or among the properties or characteristics
 - The difference between transverse and longitudinal waves.

Assessment

The revised taxonomy verb for this indicator is analyze which means to “break material into its constituent parts and determine how the parts relate to one another and to an overall structure or purpose”. In this case, students should be able to evaluate all of the parts of a wave and address the ways that they influence one another. Because the indicator is written as conceptual knowledge, assessments should require that students understand the “interrelationships among the basic elements within a larger structure that enable them to function together.” In this case, assessments must show that students understand the reasons for the ways that the characteristics and properties affect one another both mathematically and physically.

P-5.2 Compare the properties of electromagnetic and mechanical waves.

Revised Taxonomy Level 2.6 Compare conceptual knowledge

In physical science students

- ❖ “Summarize the characteristics of the electromagnetic spectrum (including the range of frequencies, wavelengths, energy, and propagation without a medium).” (PS-7.5)

It is essential for all students to

- ❖ Compare electromagnetic and mechanical waves in terms of each of the properties addressed in P-5.1

Assessment

As stated in the indicator, the major focus of assessment is to compare (detect correspondences) in the properties of mechanical and electromagnetic waves. Because the indicator is written as conceptual knowledge, assessments should require that students understand the “interrelationships among the basic elements within a larger structure that enable them to function together.” In this case, assessments must show that students understand the reasons for the difference in the two types of waves in terms of each of the listed properties and characteristics.

P-5.3 Analyze wave behaviors (including reflection, refraction, diffraction, and constructive and destructive interference).

Revised Taxonomy Level 4 Analyze conceptual knowledge

In physical science students

- ❖ “Summarize reflection and interference of both sound and light waves and the refraction and diffraction of light waves.”(PS-7.6)

It is essential for students to

- ❖ Understand both conceptually and analytically the factors that affect the behaviors of a wave
- ❖ Students should be able to summarize each behavior in terms of
 - The physical effect that each behavior has on the wave
 - The factors which influence each behavior
 - The ways that each behavior is measured
 - The accepted ways of illustrating each behavior.
 - The mathematical relationship between or among the behaviors
 - The difference in the way that the behavior is manifested in transverse and longitudinal waves.

Assessment

The revised taxonomy verb for this indicator is analyze which means to “break material into its constituent parts and determine how the parts relate to one another and to an overall structure or purpose”. In this case, students should be able to evaluate all wave behaviors and address the ways that they influence one another. Because the indicator is written as conceptual knowledge, assessments should require that students understand the “interrelationships among the basic elements within a larger structure that enable them to function together.” In this case, assessments must show that students understand the reasons for the ways that the behaviors affect one another both mathematically and physically.

P-5.4 Distinguish the different properties of waves across the range of the electromagnetic spectrum.

Revised Taxonomy Level 4.1B Distinguish conceptual knowledge

In physical science students

- ❖ “Summarize the characteristics of the electromagnetic spectrum (including the range of frequencies, wavelengths, energy, and propagation without a medium).” (PS-7.5)

It is essential for all students to

- ❖ Distinguish how the properties addressed in P-5.1 (energy, frequency, amplitude, wavelength, period, phase, and speed) distinguish the specific types of electromagnetic radiation (radio waves, microwaves, infrared, visible light, ultraviolet, x rays and gamma rays).

Assessment

As the verb for this indicator is differentiate (distinguish), the major focus of assessment should be for students to distinguish between the relevant and irrelevant parts or important from unimportant parts of presented materials. Because the verb is differentiate rather than compare, students should assess the distinguishing properties of the different parts of the electromagnetic spectrum. Because the indicator is written as conceptual knowledge, assessments should require that students understand the “interrelationships among the basic elements within a larger structure that enable them to function together.” In this case, assessments must show that students understand how the properties of waves distinguish the various types of electromagnetic radiation.

P-5.5 Illustrate the interaction of light waves with optical lenses and mirrors by using Snell's law and ray diagrams.

Revised Taxonomy Level 2.2-B Exemplify (illustrate) conceptual knowledge

In physical science students

- ❖ “Summarize reflection and interference of both sound and light waves and the refraction and diffraction of light waves.” (PS-7.6)
- ❖ Draw ray diagrams for a prism and for a converging and diverging lenses,
- ❖ Do not find the focal point or solve problems using Snell's law.

It is essential for students to

- ❖ Solve problems using Snell's law
- ❖ Use ray diagrams to illustrate the path of light and to find the location and size of the image:
 - as it passes through convex and concave of lenses
 - as it reflects off convex and concave mirrors

Assessment

The verb exemplify (illustrate) means to find a specific example or illustration of a concept or principle, therefore the major focus of assessment will be for students to give examples that show that they understand the path of light as when it encounters various lenses and mirrors. Because the indicator is written as conceptual knowledge, assessments should require that students understand the “interrelationships among the basic elements within a larger structure that enable them to function together.” In this case, assessments must show that students understand how the shape of the device determines the nature of the image and the path of the light.